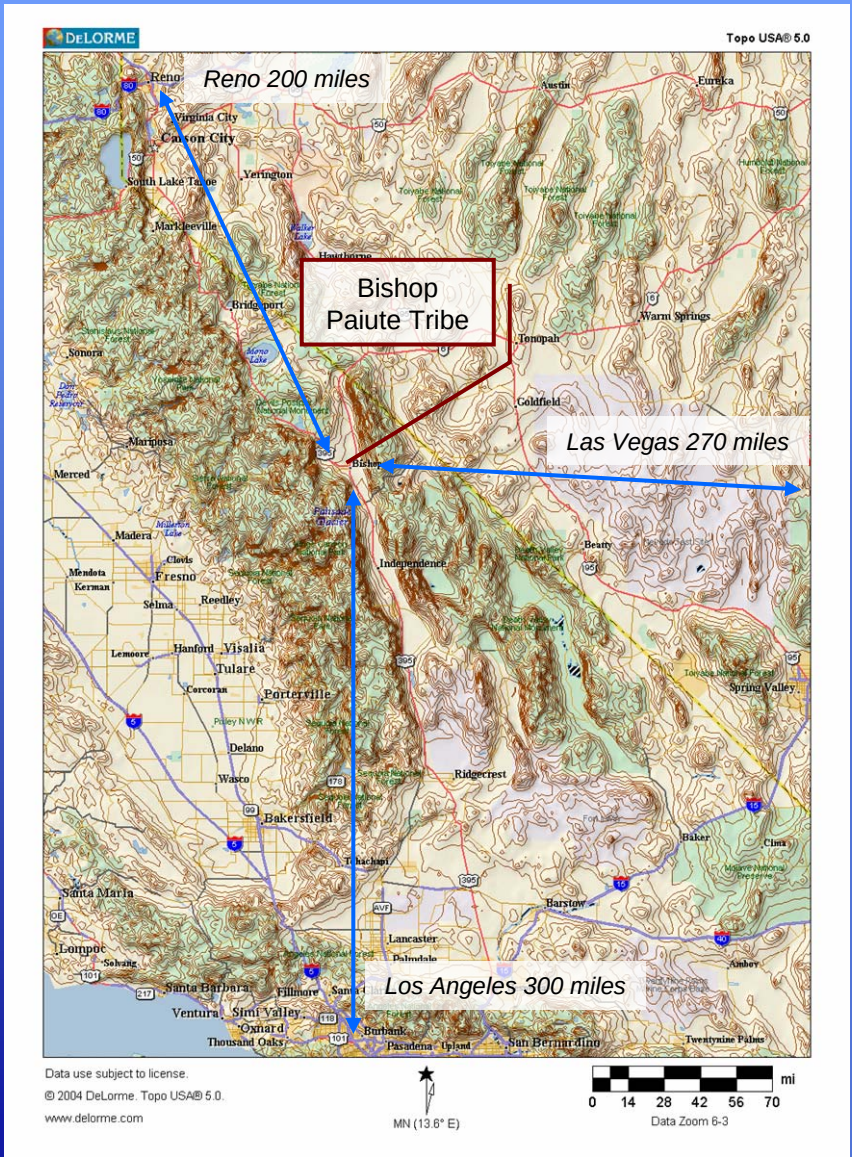
Where does the dust come from?

An analysis of the days with the highest particulate concentration on the Bishop Paiute Reservation 2003-2006

PHOTO COURTESY OF GBUAPCD

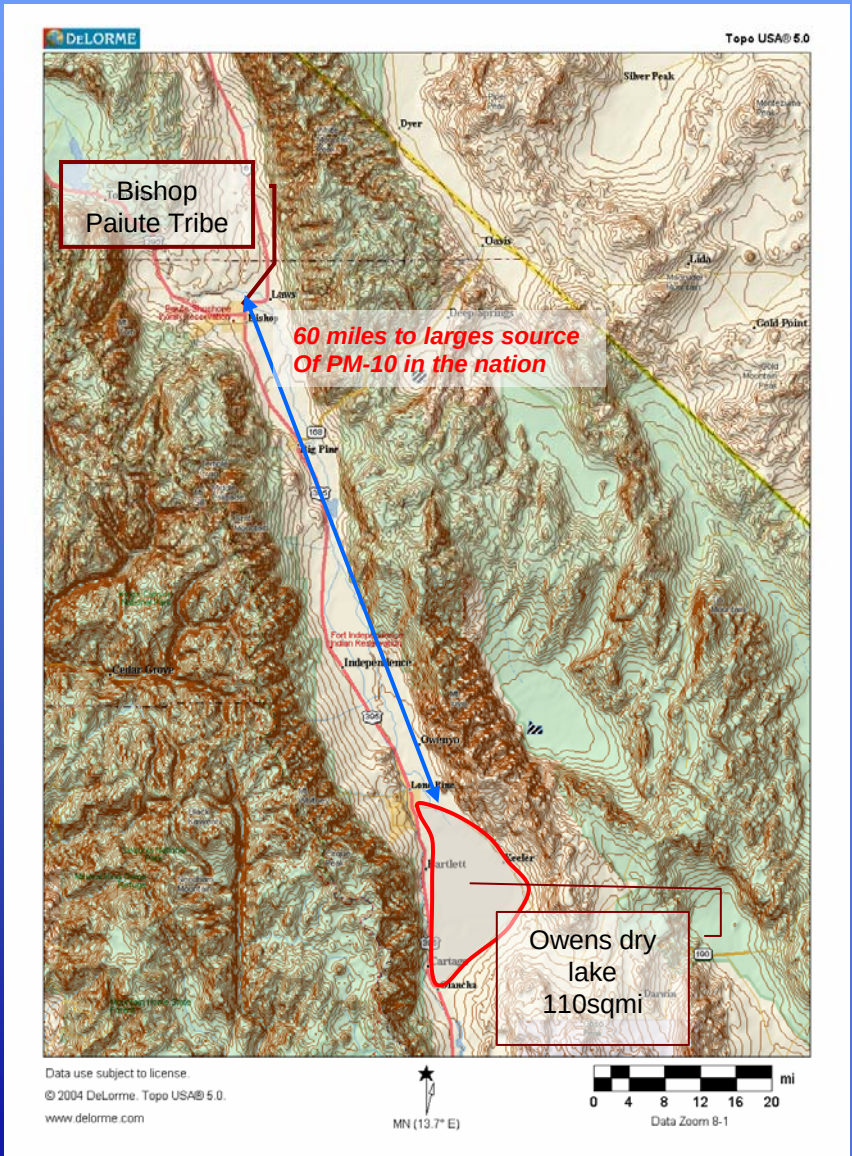
Toni Richards, Ph.D.
Air Quality Specialist
Bishop Paiute Tribe
Environmental Management Office

Where is the Bishop Paiute Tribe?



- On the California-Nevada Border
- In the “deepest valley” at 4,000ft between the Sierra Nevada and White Mountains
- 200 miles South of Reno
- 270 miles East of Las Vegas
- 300 miles North of Los Angeles

Why are we interested in dust?



- The Bishop Paiute Reservation is only 60 miles North of the Owens Dry Lake
- The **largest source of PM-10 in the nation**
- Releasing thousands of tons of dust into the air each year

What makes airborne dust?

Simple answer: wind + soil disturbance

- The dry lake was once a lake
- Early in the 20th century it was drained when an aqueduct was built to transport water to the City of Los Angeles
- Alkali soils on the lakebed + moisture = a surface that is very susceptible to wind erosion
- Winds pick up sand which in turn stirs up smaller particles, creating airborne dust

Boing!

What does the dry lake look like?

Before, during, more during

What questions are we trying to answer?

1. Do dust episodes on the dry lake impact the Bishop Paiute Reservation?
   - Can our data and methods allow us to sort high PM-10 days into those where there is likely to have been an impact from the dry lake?
2. Have things changed since the implementation of controls? ←*(hard question)*

What are we studying?

High dust days as measured by PM-10

1. Started with days with at least one hour over 100µg/m³ → too many of these for detailed study
2. Selected days with at least one hour over 200µg/m³
   - All days that exceed the California and Bishop tribal 24-hour standard (50µg/m³) have at least 1 hour over 200µg/m³
   - Other significant dust episodes have hourly concentrations in this range
   - Excludes episodes have a high fine fraction → smoke

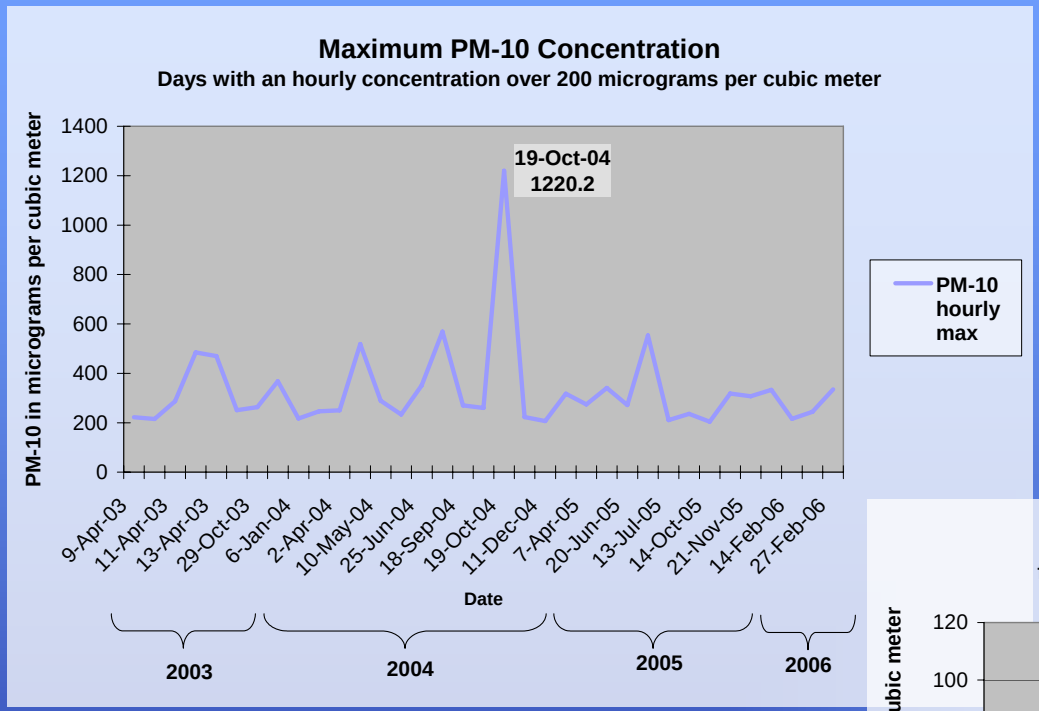
How many episodes are there?

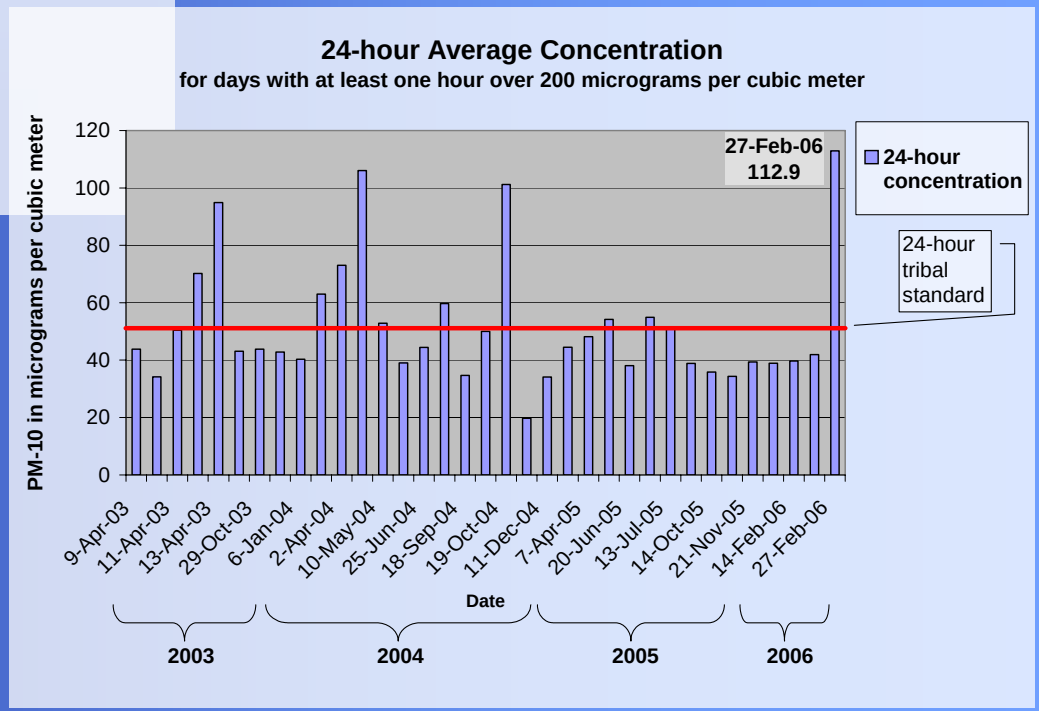
- 35 days with at least one hour with a concentration over 200µg/m³
  - 2003 – 10 days *(8 months of data only)*
  - 2004 – 14 days
  - 2005 – 10 days *(some caused by local construction)*
  - 2006 – 3 days *(6 months of data only)*

What do the episodes look like?

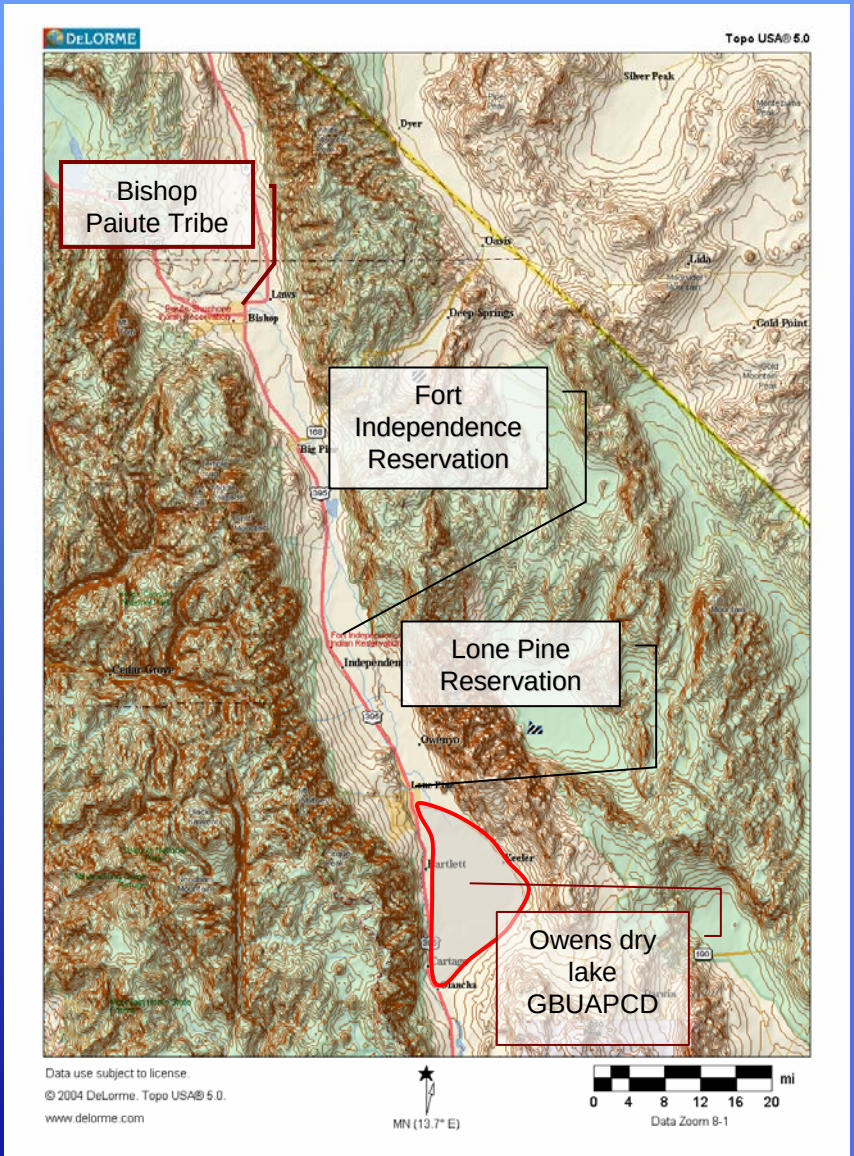
- Maximum hourly concentration 1,200µg/m³
- Typical wind gust at max concentration 30-40mph
- Typical wind direction at max concentration SE
  - ESE to SSE on 54% of days)
- Most episodes involve frontal passage (66%)

Hourly Maxima and 24-Hour Concentrations



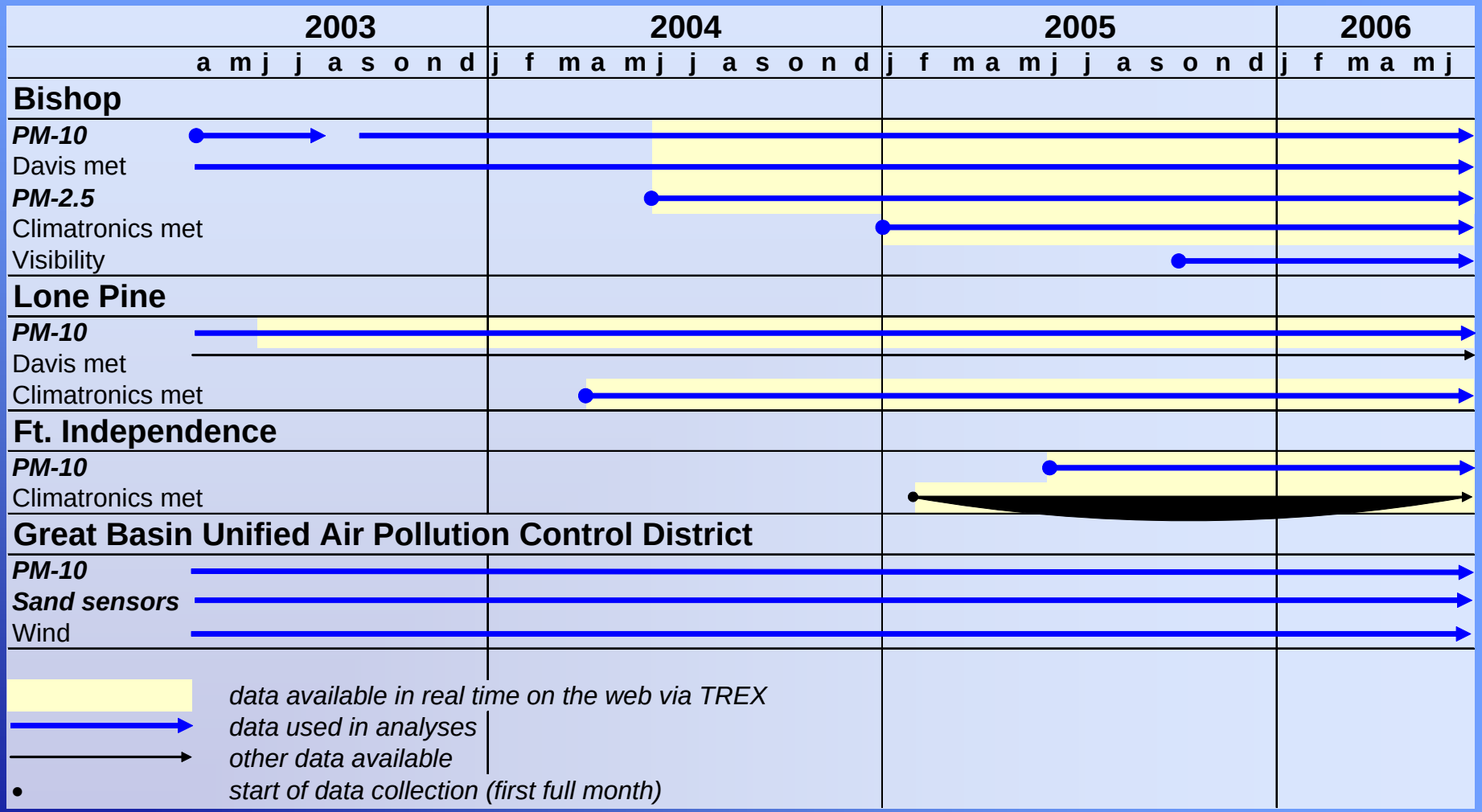


Where do the data come from?



- The Bishop Paiute Tribe's Air Quality Program
- The Lone Pine Paiute Shoshone Reservation's Air Quality Program
- The Ft. Independence Reservation's Air Quality Program
- The Great Basin Unified Air Pollution Control District
  - Responsible for mitigation efforts on the dry lake

Data Availability



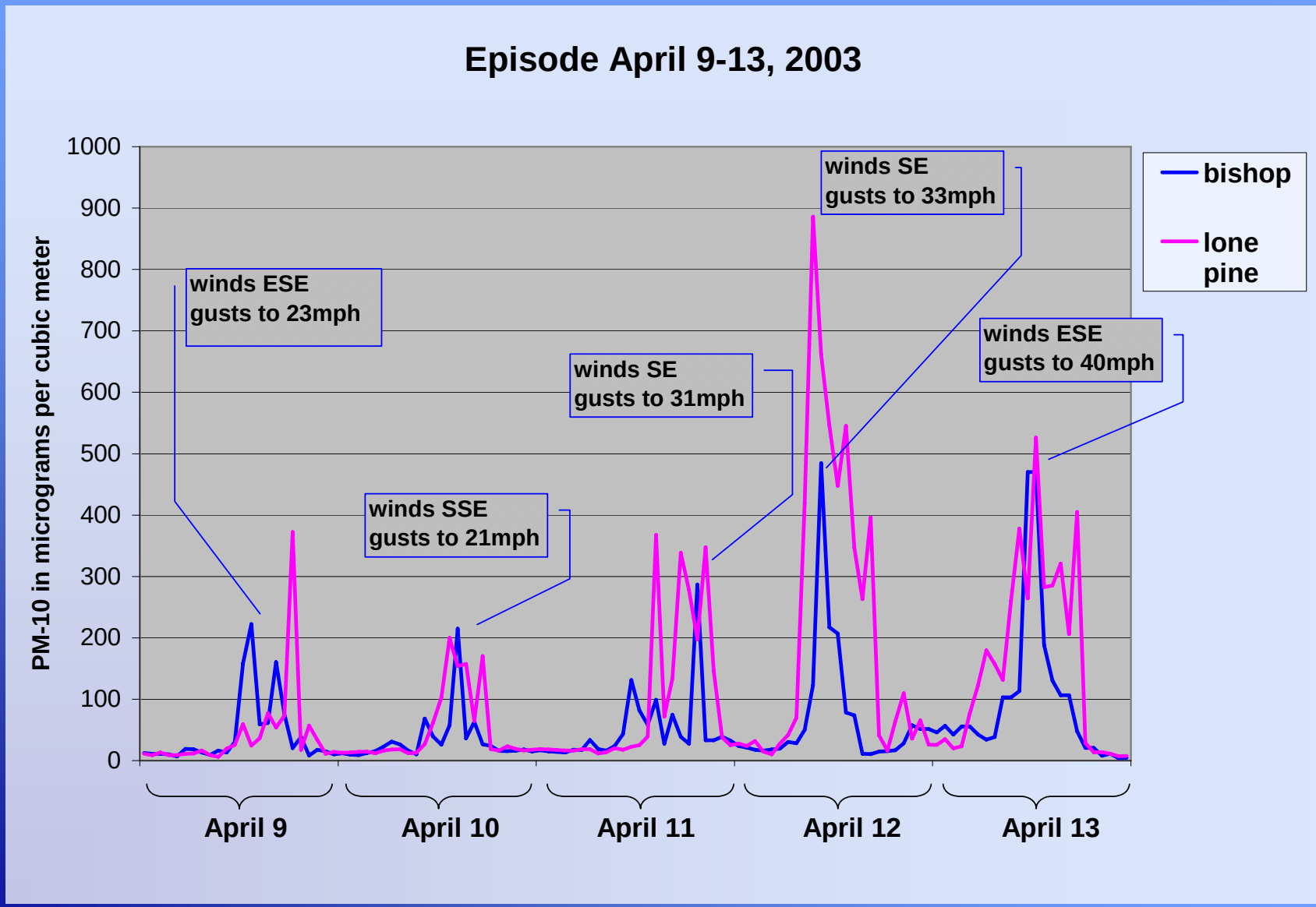
Analysis Methods

- 2003 forward
  - Graphical methods, adding new data as they become available
  - Maps of activity on the dry lake
  - Modeling of back trajectories with HySplit
- 2005 forward
  - Pollution roses
  - Visibility information *(photos of a fixed location, taken at the top of each hour)*

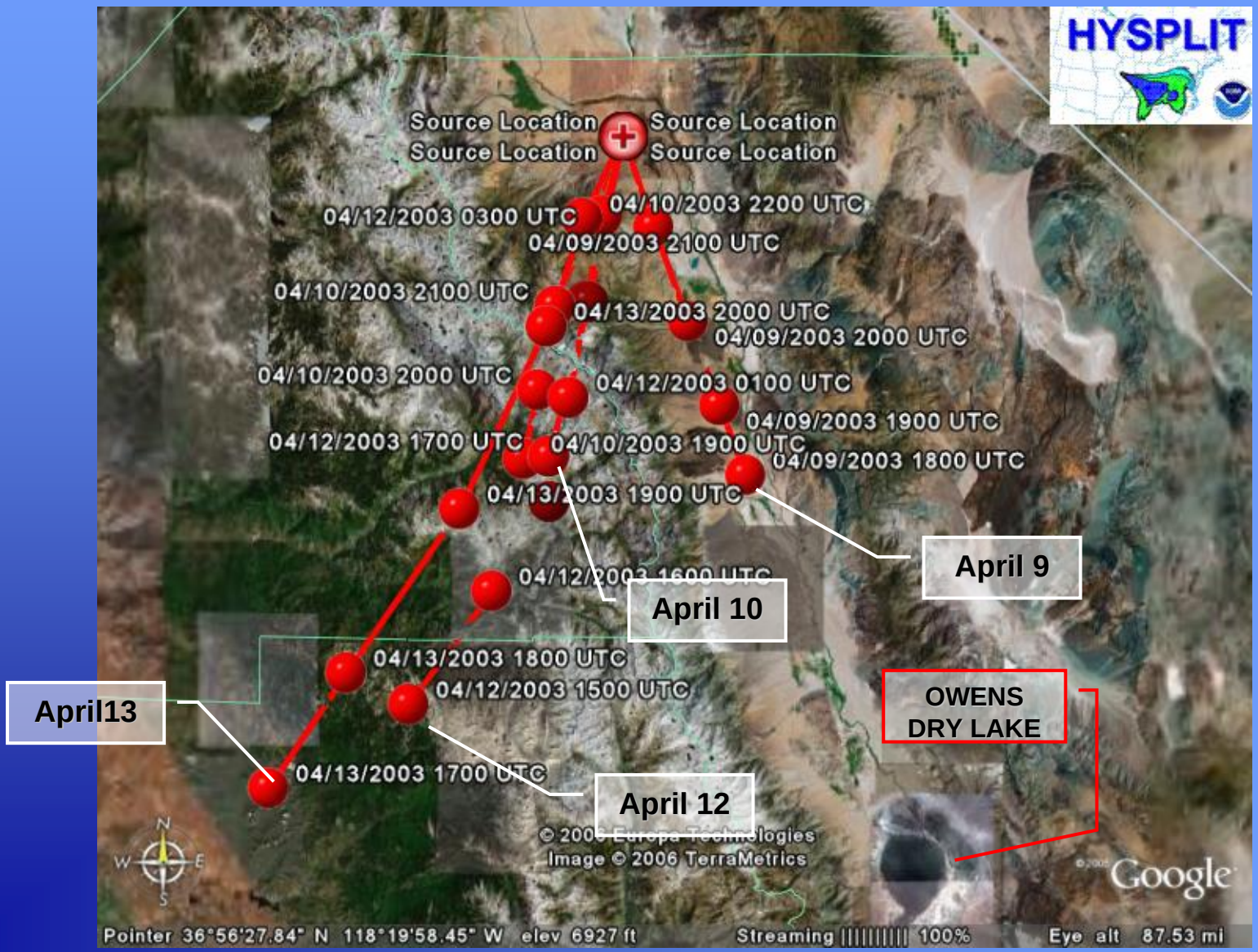
Now let's look at some sample episodes, starting with 2003

- One episode for each year
- Typically a multi-day event
- Graphs, back trajectories, maps
- Starting in 2005, pollution roses and visibility
- This analysis was repeated for every day with at least one hour with a concentration over 200µg/m³

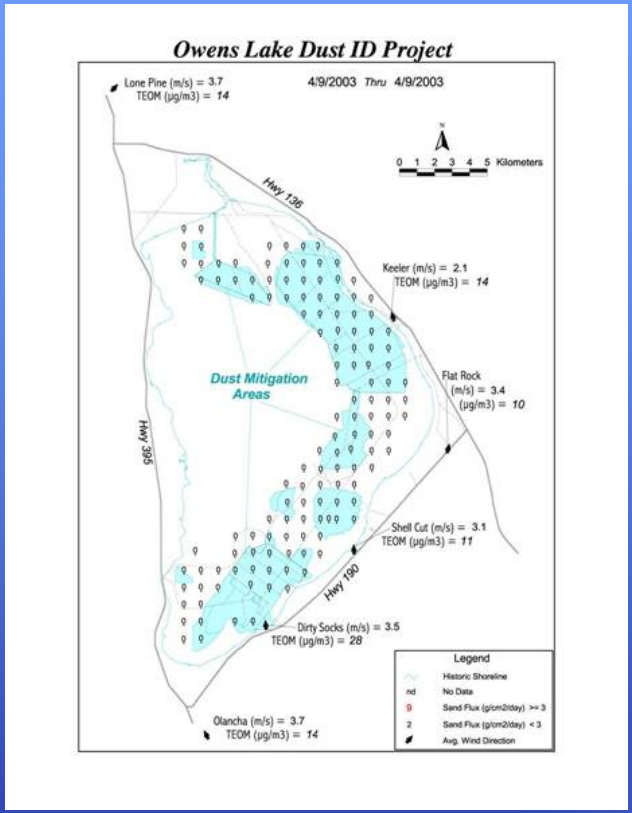
5-day episode, Apr. 9-13, 2003



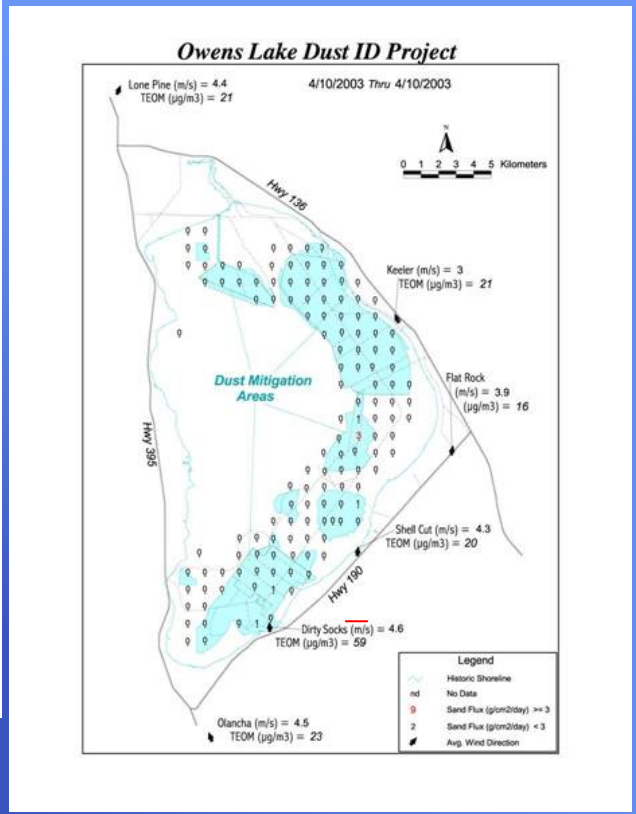
Back-trajectory, April 9-13, 2003



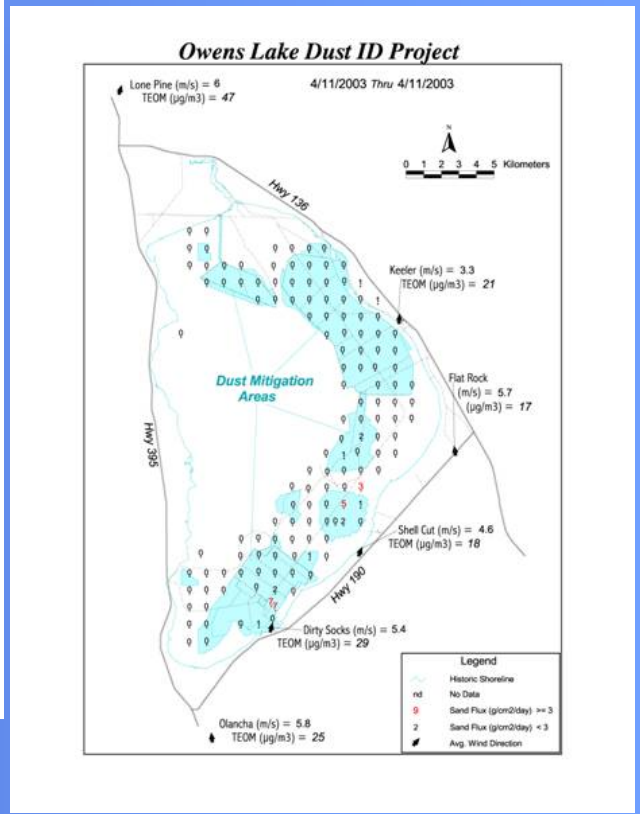
Dry Lake Activity April 9-13, 2003



April 9



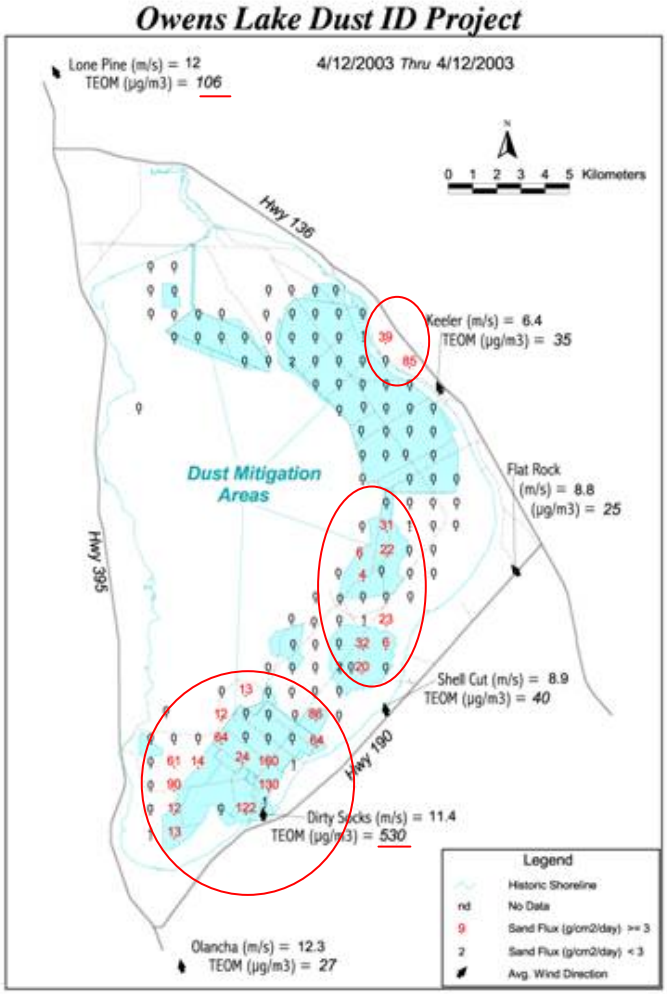
April 10



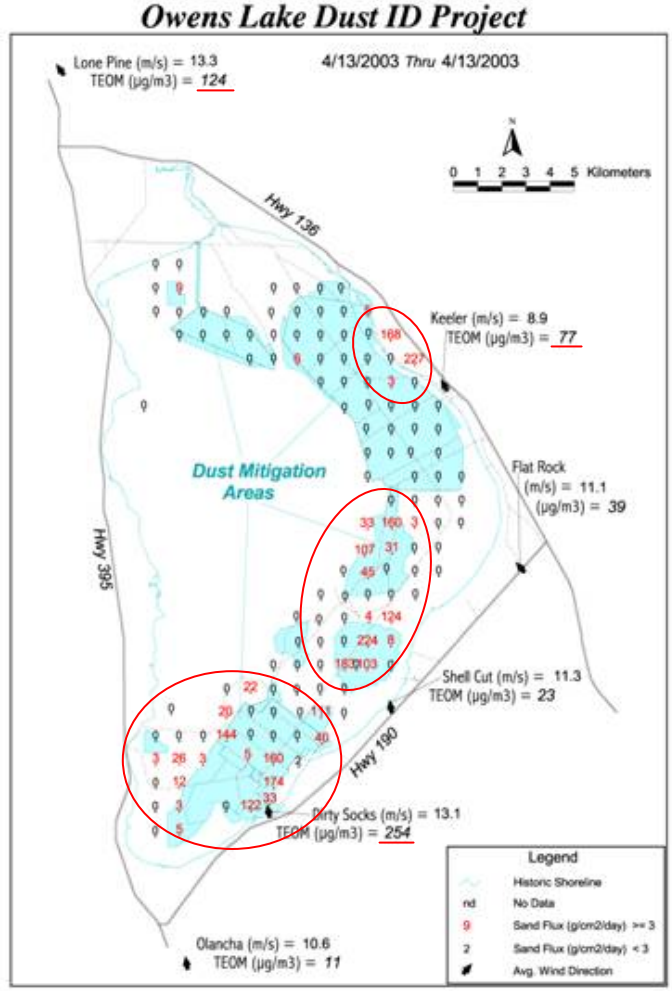
April 11

Maps courtesy of GBUAPCD

Dry Lake Activity April 9-13, 2003



April 12



April 13

Maps courtesy of GBUAPCD

What did we learn?

ALL DAYS

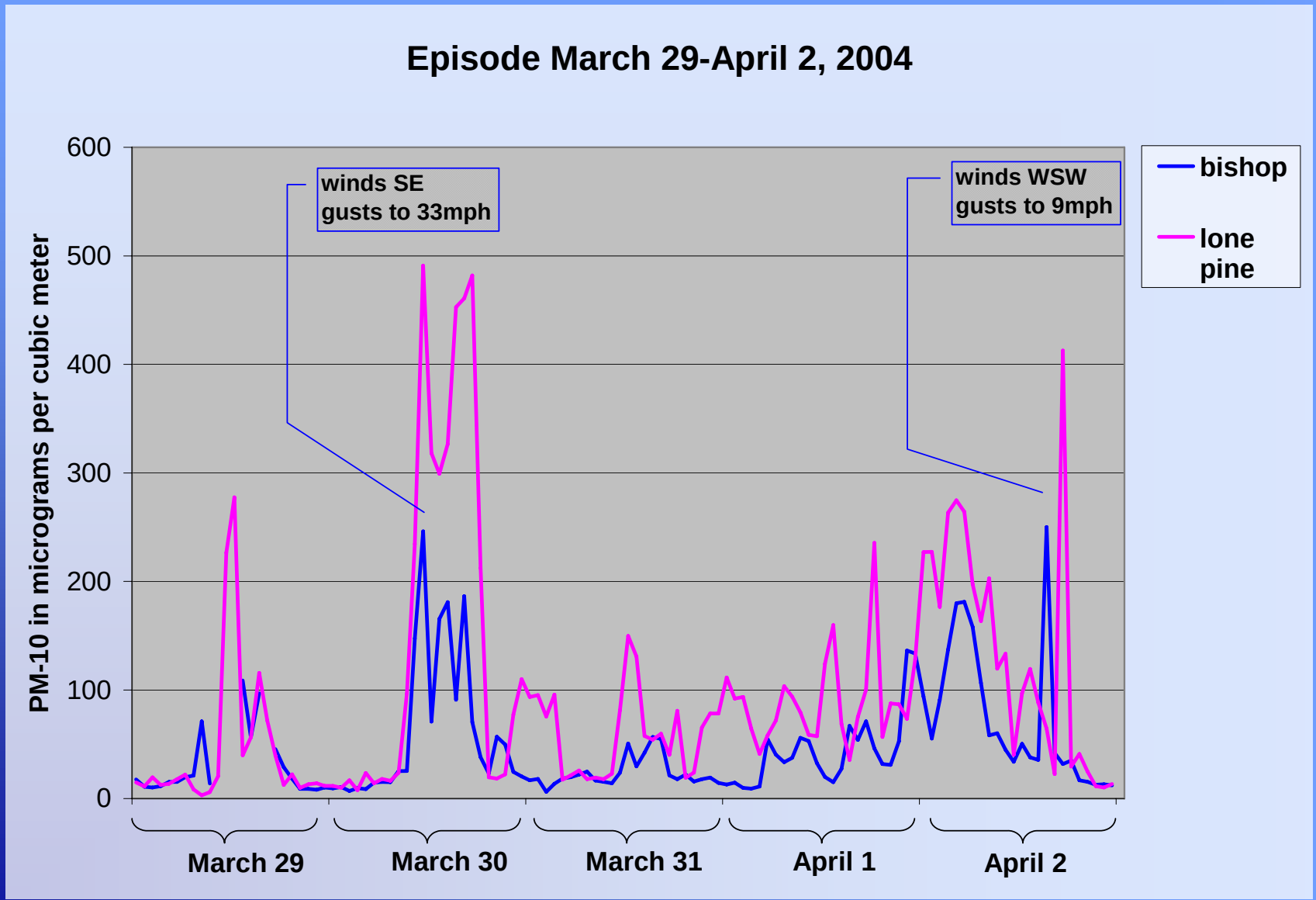
- Winds are from SE quadrant + evidence of frontal passage
- High concentrations at Lone Pine Reservation

ONLY 2 DAYS

- Activity on dry lake (though TEOMS around lake have high concentrations on 3 days)

HySplit was of limited value

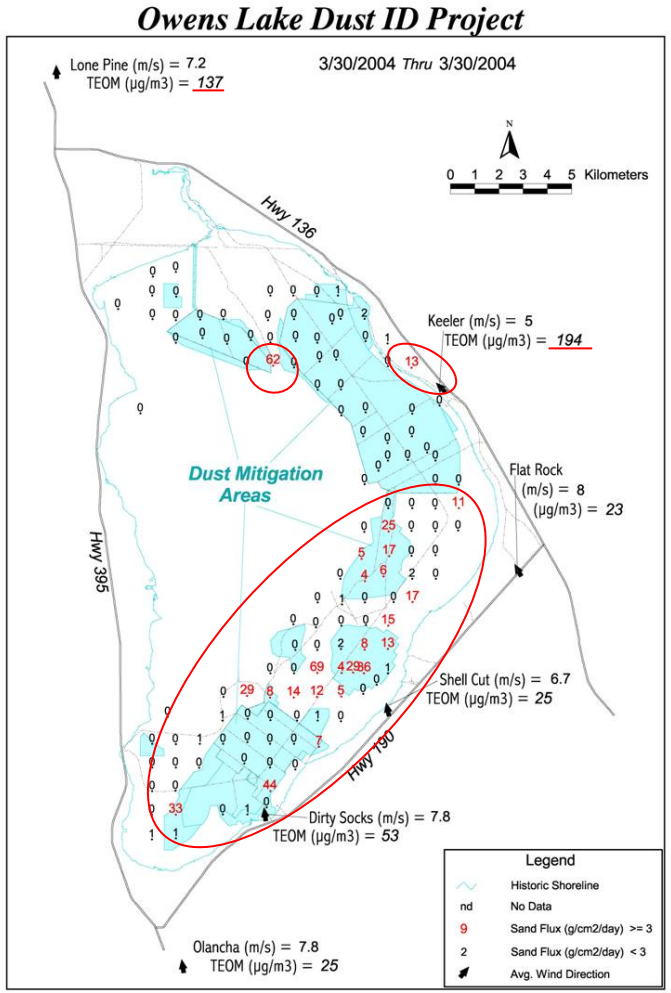
5-day episode, March 29- April 2, 2004

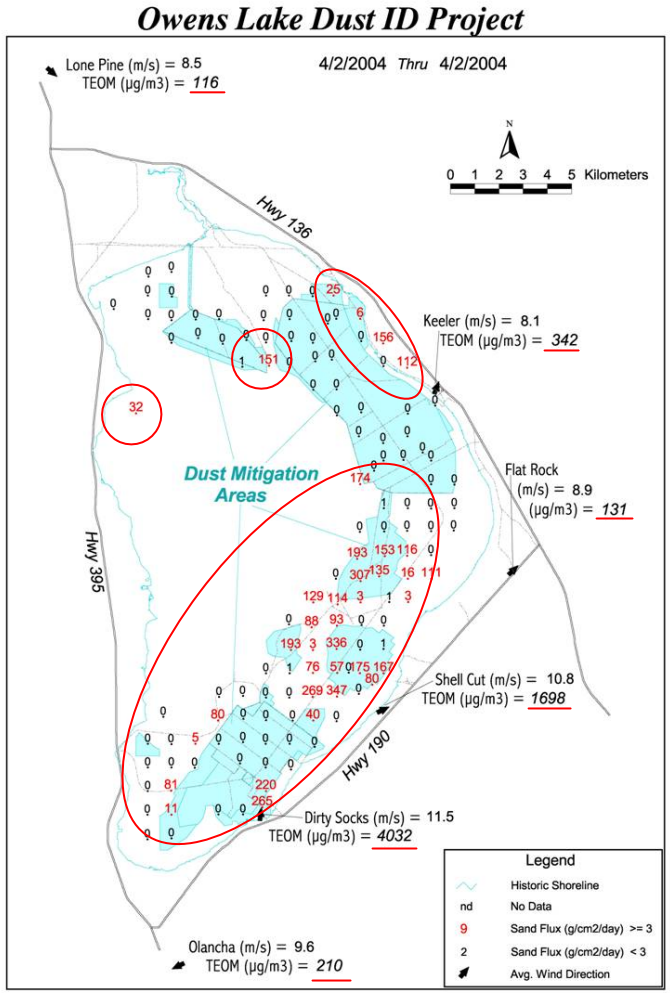


Back-trajectory March 30 and April 2, 2004

DRY LAKE RE-RUN

Dry lake March 30 and April 2, 2004





March 30

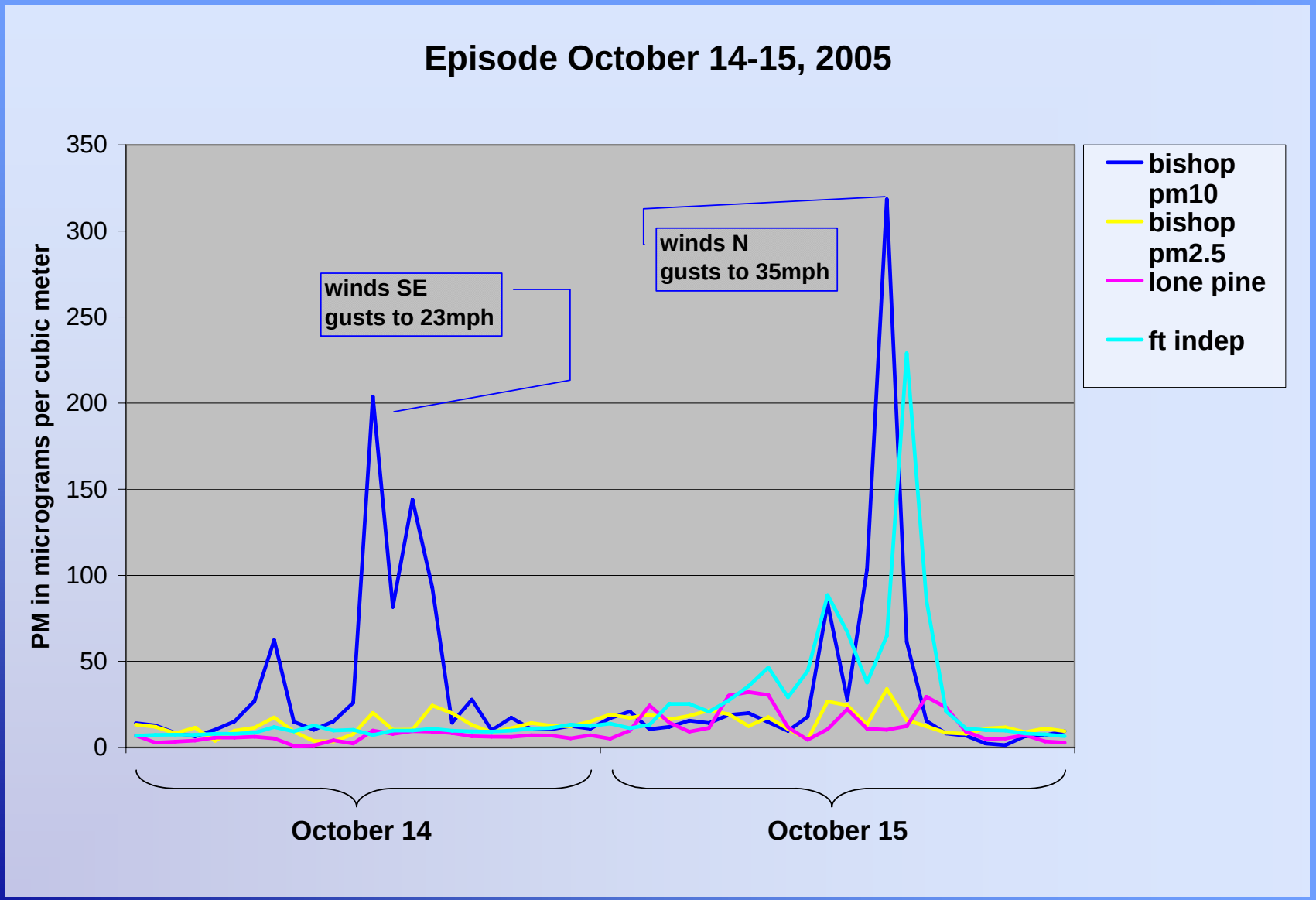
Maps courtesy of GBUAPCD

April 2

What did we learn?

- Wind direction varied, with an interesting reversal
- High concentrations at Lone Pine Reservation
- Activity on dry lake and on TEOMS around lake
- HySplit worked well

2-day episode, October 14-15, 2005

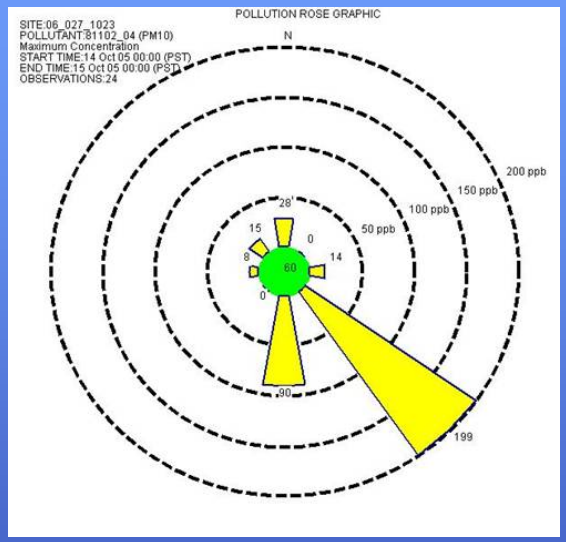


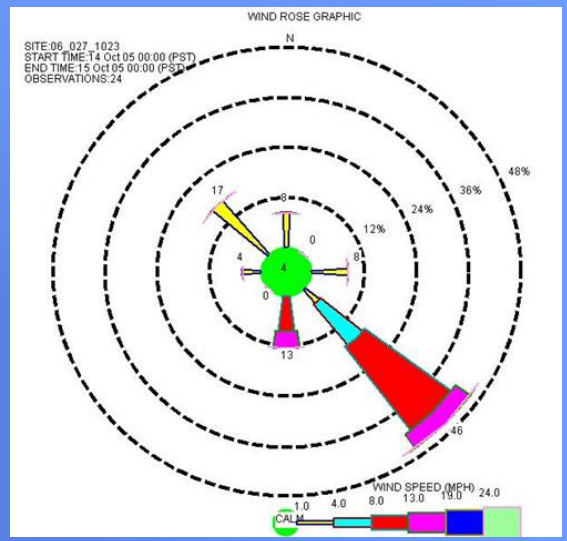
Wind and Pollution Roses Oct 14-15, 2005

PM-10

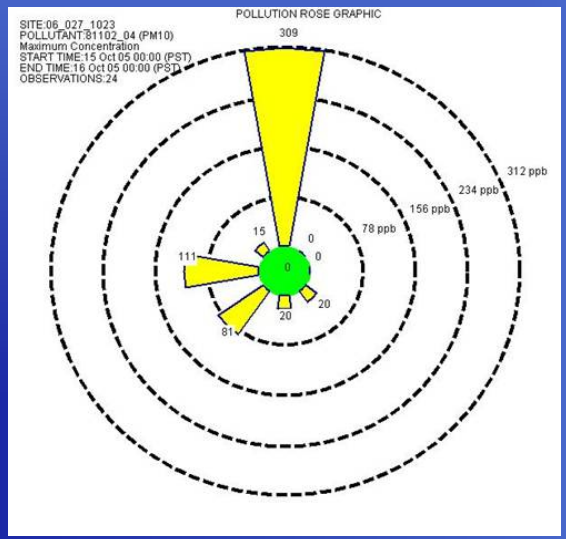
Wind

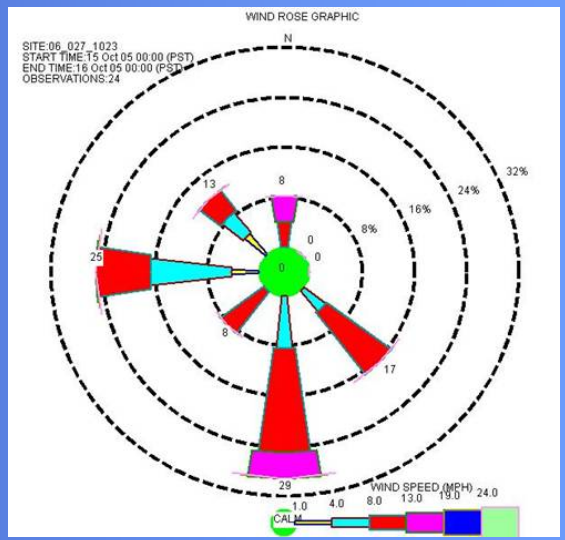
Oct 14



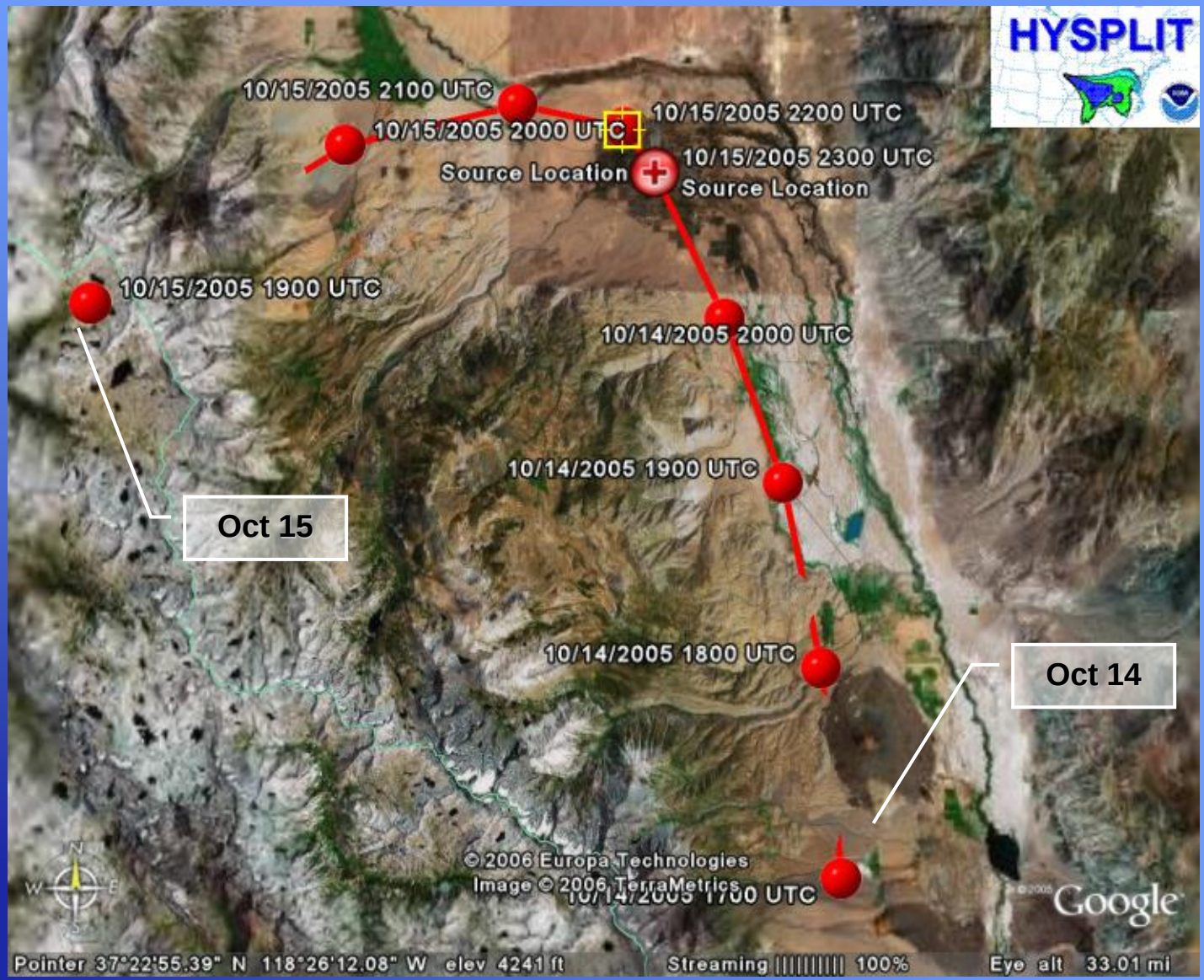


Oct 15

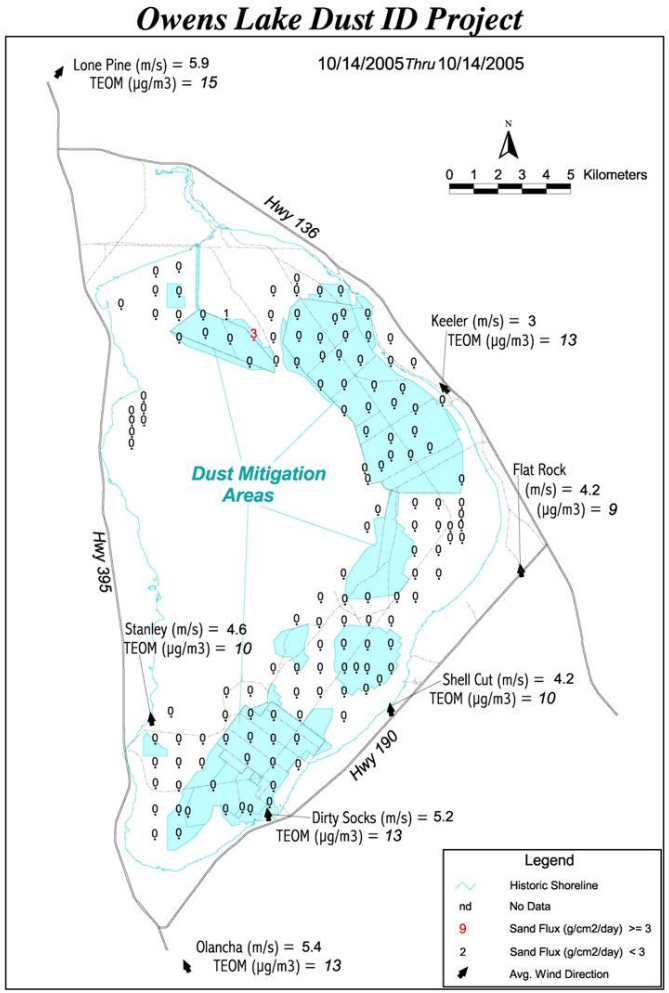


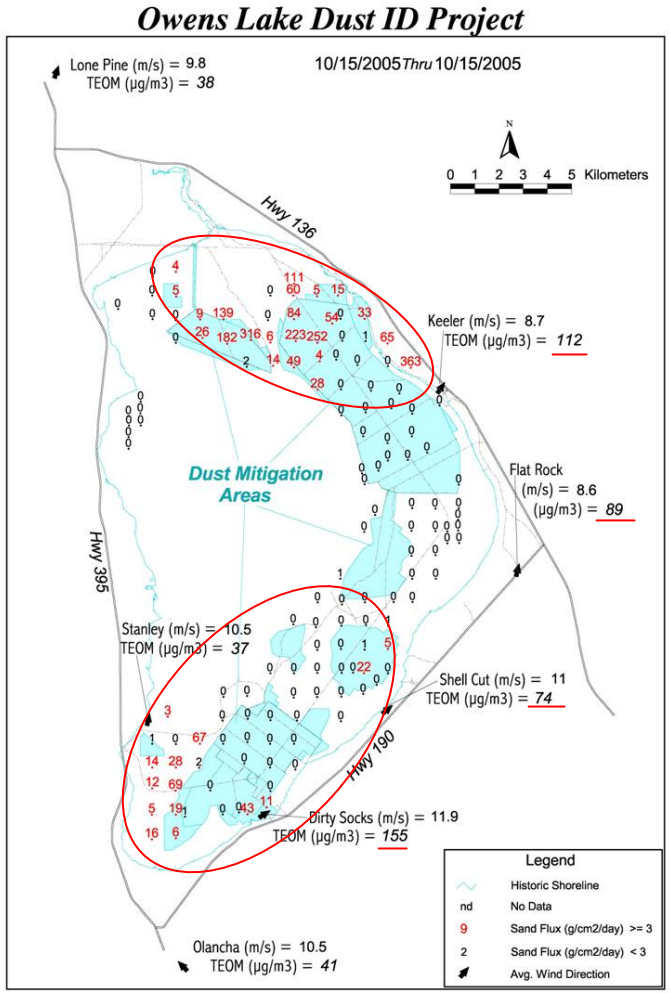


Back-trajectory October 14-15, 2005



Dry Lake Activity October 14-15, 2005





October 14

October 15

Maps courtesy of GBUAPCD

Visibility October 14-15, 2005

Oct 14

Oct 15

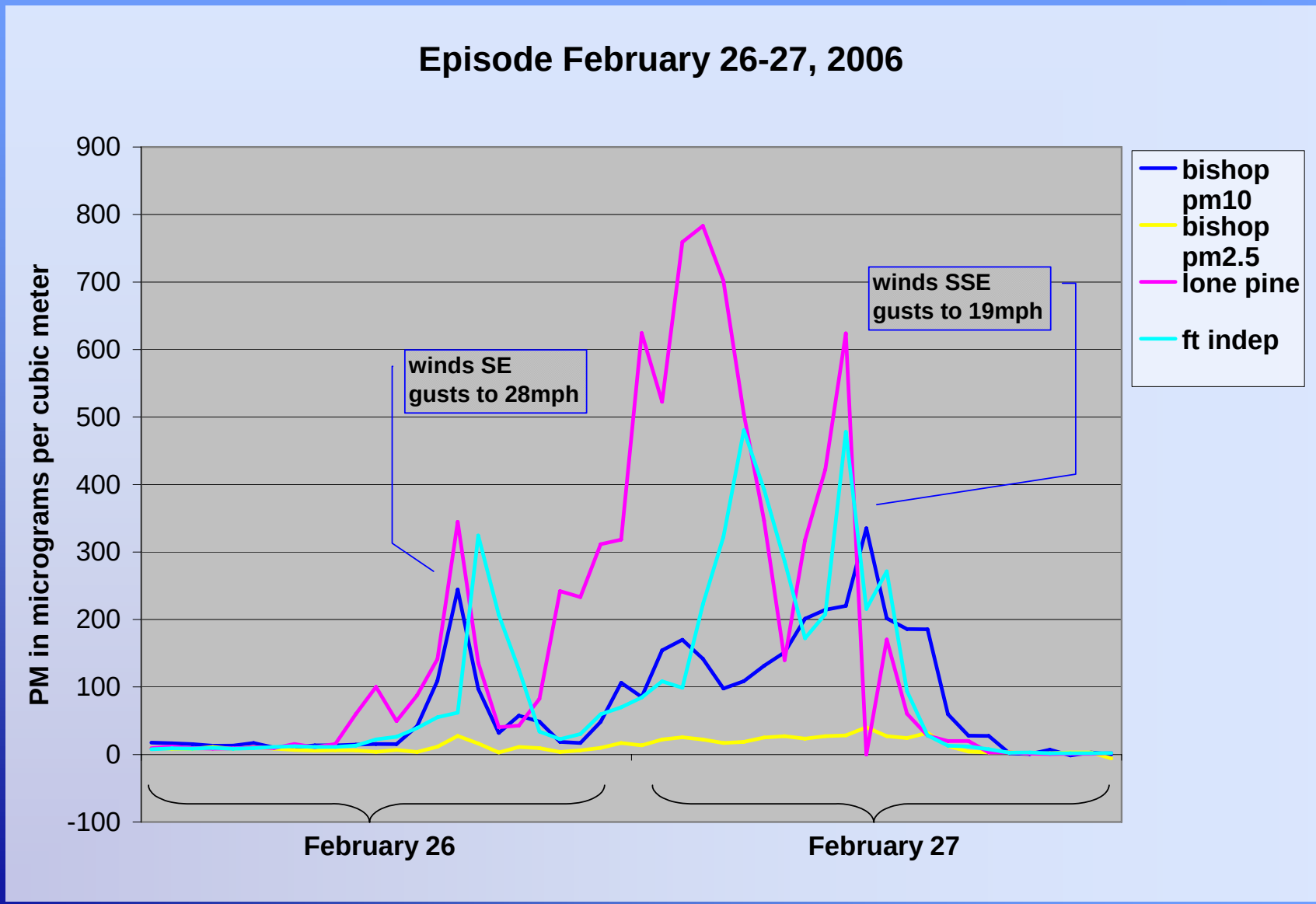
What did we learn?

- Wind direction varied, with an interesting reversal
- Good agreement of wind gust information with pollution/wind rose
- No high concentrations Lone Pine
- Visibility information is strongly affected by weather (water vapor), but is useful for identifying storms
- HySplit is in general agreement with other wind information

ONE DAY ONLY

- Activity on dry lake and on TEOMS around lake
- High concentration at Ft. Independence

2-day Episode, February 26-27, 2006

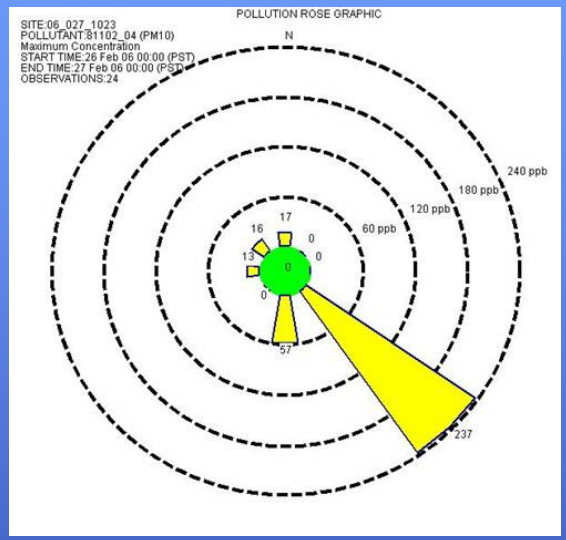


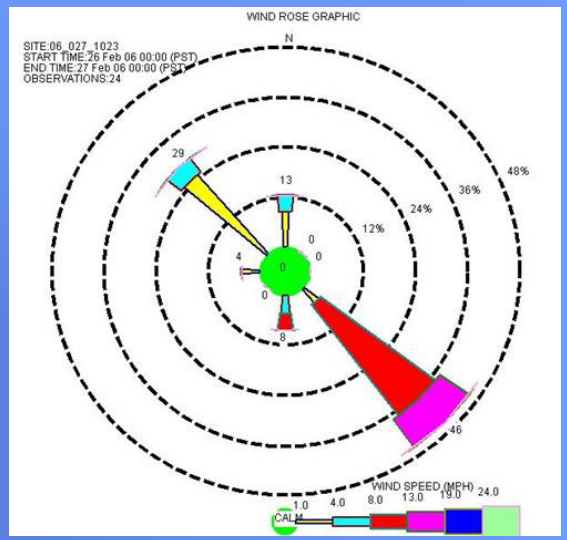
Wind and Pollution Roses
February 26-27, 2006

PM-10

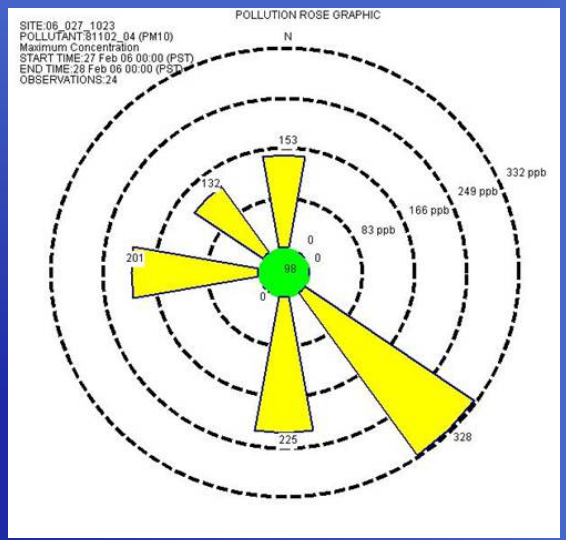
Wind

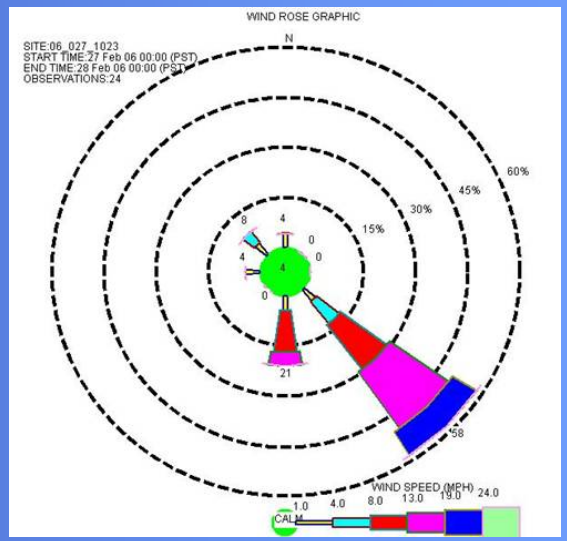
Feb 26



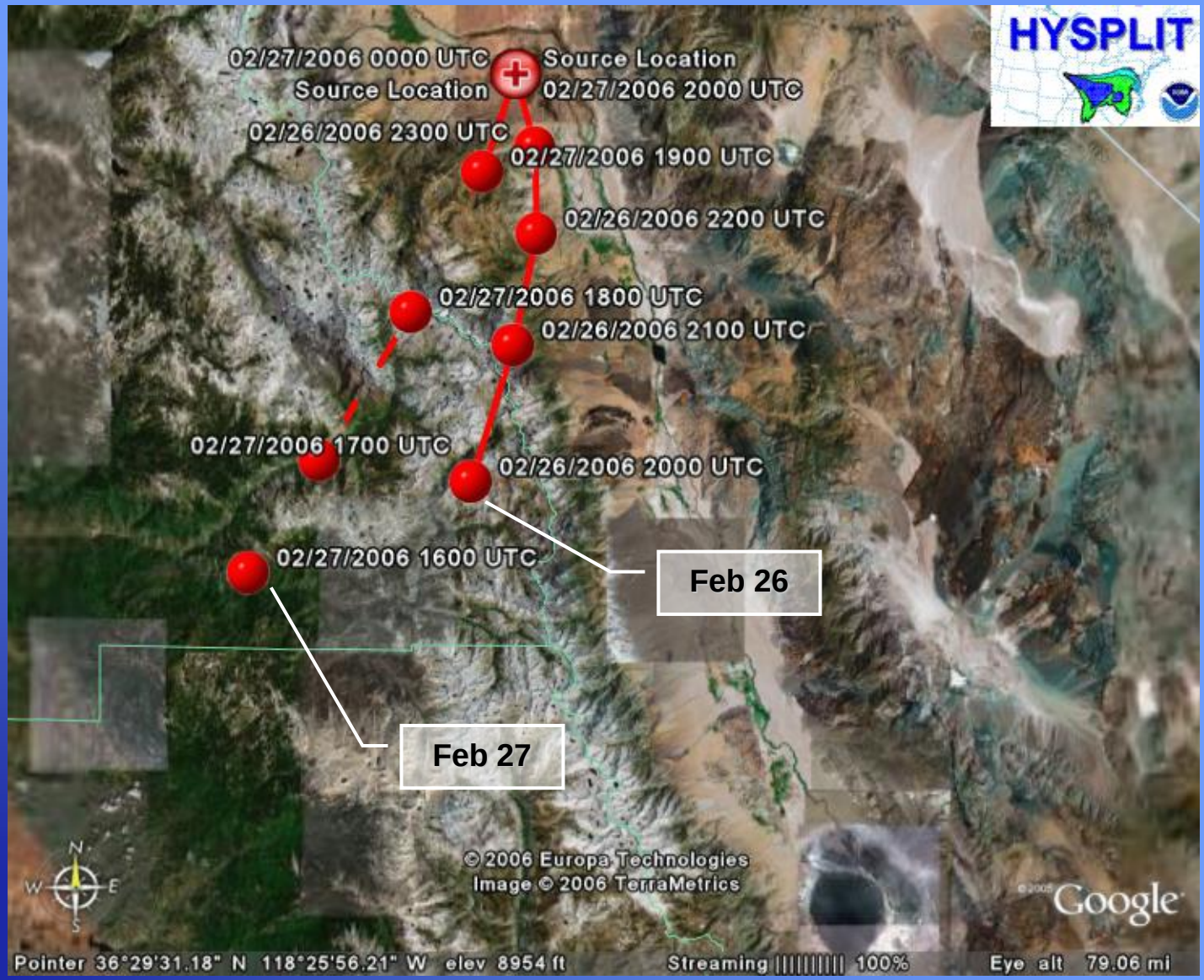


Feb 27

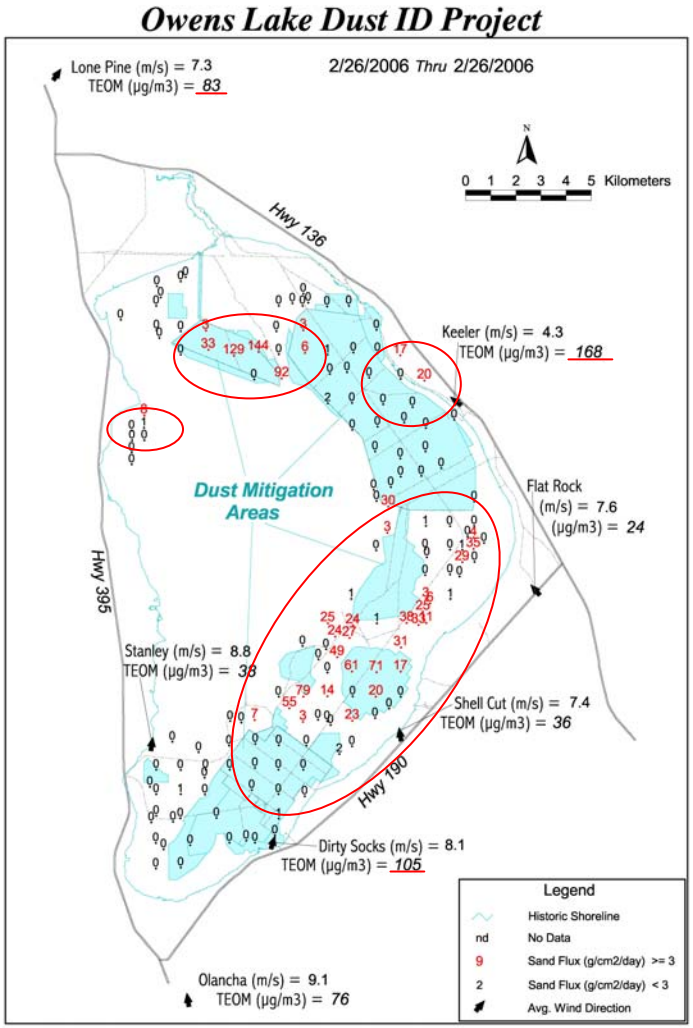


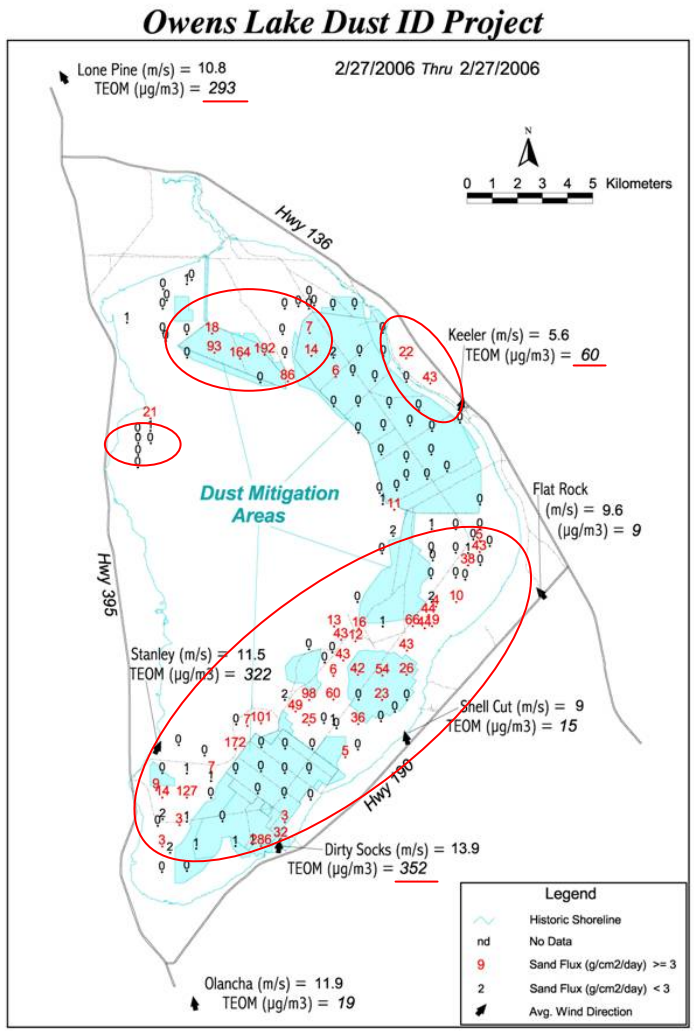


Back-trajectory February 26-27, 2006



Dry Lake Activity February 26-27, 2006





February 26

February 27

Visibility February 26-27, 2006

Feb 26

Feb 27

What did we learn?

- Owens Valley-wide event
- Prolonged episode with high concentrations – highest 24-hour concentration
- Wind direction from SE quadrant
- Moderate agreement of wind gust information with pollution/wind rose
- High concentrations Lone Pine and Ft. Independence
- Visibility information is strongly affected by weather (water vapor)
- HySplit was of limited value
- Activity on dry lake and on TEOMS around lake

Can dust affect visibility?
Example: August 31, 2006

- PM-10 at max 214.2µg/m³
  - PM-2.5 = 24
  - fine fraction = 11.2%
- Impact on visibility (as measured here) depends a lot on the angle of the sun
- Wind at max SSE, gusts to 15mph
- Lone Pine
  - PM-10 = 21.1
- Ft. Independence
  - PM-10 = 24.2

What can we conclude?

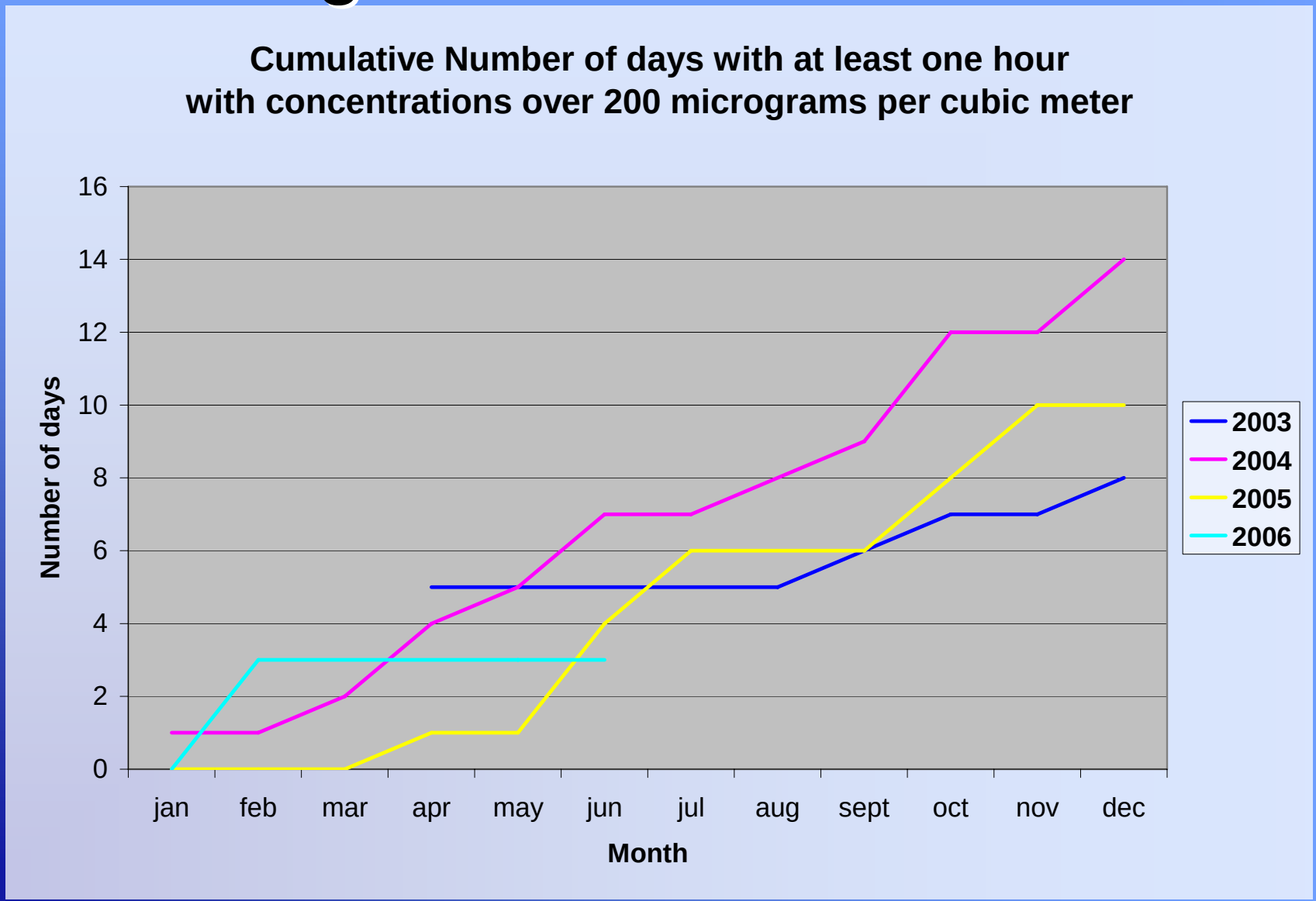
- We can separate high PM-10 days into those where the dry lake probably had an impact and those where it probably did not
  - 49% of high dust days also have high activity on the dry lake
  - 46% of high dust days are also high dust days for the Lone Pine Reservation
  - 33% of high dusts days are also high dust days for the Ft. Independence Reservation *(since June 2005)*

- Nearly half the time, there is evidence of activity on the dry lake when the Bishop Reservation has high PM-10 concentrations

Have there been changes over time?

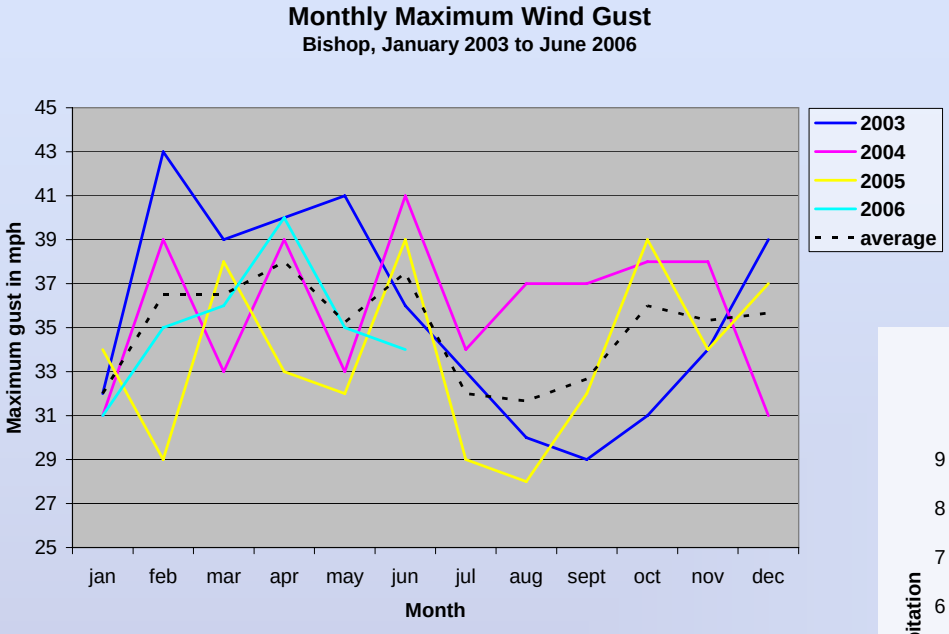
- Mitigation has proceeded
  - 1998 State Implementation Plan
    - 10 square miles by 2001
    - 13.5 square miles by 2002
    - 16.5 square miles by 2003
  - 2003 State Implementation Plan
    - 29.8 square miles by 2006
  - Work began in late 2001
  - 30 acres have shallow flooding or managed vegetation (salt grass)
- But the weather has not been consistent…

Cumulative number of days with high PM-10 concentrations

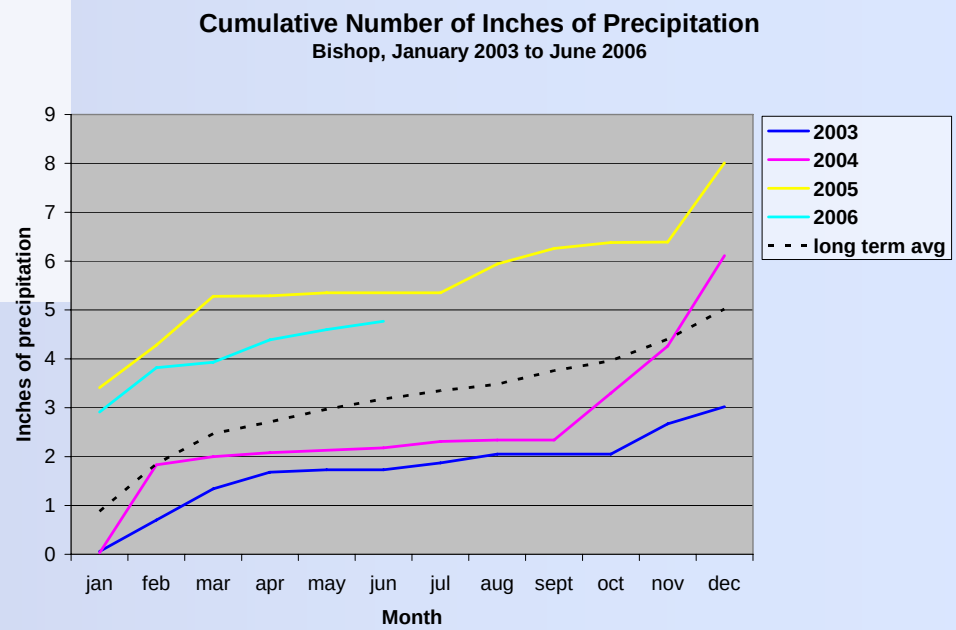


Wind and rain

Maximum wind gust



Precipitation



Conclusions

- Dry lake emissions probably impact the Bishop Paiute Reservation
- Not enough data for firm conclusions about trends
  - Not enough years
  - Too much variability in the weather

Policy Implications

- Litigation in process between GBUAPCD and LADWP over additional controls
- Elimination of federal PM-10 standard for rural areas may be important
- But, CA standard still applies and may come into play *(50µg/m³)*
- Bishop Paiute Tribe has adopted its own PM standards *(same as CA)*

ACKNOWLEDGEMENTS

- **The Bishop Paiute Tribal Council and Tribal Members**
- **US EPA and EPA Region 9**
- **My colleagues in the Environmental Management Office**
- **GBUAPCD**
- **Owens Valley Tribal Air Programs *(Lone Pine and Ft. Independence)***
- **IPS MeteoStar and T&B Systems**

CONTACT INFORMATION

Toni Richards

Air Quality Specialist

trichards@bishoptribeemo.com

www.bishoptribeemo.com